

Application No. 09/476,910
Response to Office Action

Customer No. 01933

Listing of Claims:

1. (Currently Amended) An image processing apparatus for assuming a characteristic of a virtual image sensing optical system, and applying a blur effect corresponding to a preset in focus state to a captured image, comprising:

5 an image input unit for capturing image information including distance information to each portion of an object to be photographed;

10 a parameter input unit for inputting a parameter from which an effective aperture and focal length of the an assumed image sensing optical system can be derived;

an in-focal pint point position designation unit for designating an in-focal pint point position of the assumed image sensing optical system;

15 a blur state calculation unit for calculating a blur state from the distance information input by said image input unit, the in-focal pint point position designated by said in-focal pint point position designation unit, and the parameter input by said parameter input unit; and

20 an image processing unit for applying the a blur effect to the image input by said image input unit in correspondence with the blur state calculated by said blur state calculation unit;

wherein the in-focal point position designated by said in-focal point position designation unit is determined using the

Application No. 09/476,910
Response to Office Action

Customer No. 01933

25 distance information included in the image information, based on
a position which is designated by a user in an image
corresponding to the image information.

Claims 2 and 3 (Canceled).

4. (Currently Amended) An image processing apparatus for
~~assuming a characteristic of a virtual image sensing optical~~
~~system, and applying a blur effect corresponding to an in focus~~
~~state to a captured image, comprising:~~

5 an image input unit for capturing image information
including distance information to each portion of an object to be
photographed;

10 a parameter input unit for inputting a parameter from which
an effective aperture and focal length of ~~the~~ an assumed image
sensing optical system can be derived;

an in-focal pint point position designation unit for
designating an in-focal pint point position of the assumed image
sensing optical system;

15 a confusion circle calculation unit for calculating a
confusion circle from the distance information input by said
image input unit, the in-focal pint point position designated by
said in-focal pint point position designation unit, and the
parameter input by said parameter input unit;

Application No. 09/476,910
Response to Office Action

Customer No. 01933

a blur state calculation unit for calculating a blur state
20 using a point spread function ~~(PSF)~~ within a range corresponding
to a size of the confusion circle calculated by said confusion
circle calculation unit; and

an image processing unit for applying ~~the~~ a blur effect to
the image input by said image input unit in correspondence with
25 the blur state calculated by said blur state calculation unit;

wherein the in-focal point position designated by said in-
focal point position designation unit is determined using the
distance information included in the image information, based on
a position which is designated by a user in an image
30 corresponding to the image information.

5. (Currently Amended) An image processing method of
assuming a characteristic of a virtual image sensing optical
system, and applying a blur effect corresponding to a preset
in-focus state to a captured image, comprising the steps of:

5 capturing image information including distance information
to each portion of an object to be photographed;

inputting a parameter capable of deriving an effective
aperture and focal length of the ~~an~~ assumed image sensing optical
system;

10 designating an in-focal ~~pint~~ point position of the assumed
image sensing optical system;

Application No. 09/476,910
Response to Office Action

Customer No. 01933

calculating a blur state from the input distance information, the designated in-focal pint point position, and the input parameter; and

15 applying the a blur effect to the input image in correspondence with the calculated blur state;

wherein the in-focal point position designated by said in-focal point position designation unit is determined using the distance information included in the image information, based on a position which is designated by a user in an image corresponding to the image information.

6. (Currently Amended) An image processing method of assuming a characteristic of a virtual image sensing optical system, and applying a blur effect corresponding to an in-focus state to a captured image, comprising the steps of:

5 capturing image information including distance information to each portion of an object to be photographed;

inputting a parameter from which an effective aperture and focal length of the an assumed image sensing optical system can be derived;

10 designating an in-focal pint point position of the assumed image sensing optical system;

calculating a confusion circle from the input distance information, the designated in-focal pint point position, and the input parameter;

Application No. 09/476,910
Response to Office Action

Customer No. 01933

15 calculating a blur state using a point spread function (PSF)
within a range corresponding to a size of the calculated
confusion circle; and

applying the a blur effect to the input image in
correspondence with the calculated blur state;

20 wherein the in-focal point position designated by said in-
focal point position designation unit is determined using the
distance information included in the image information, based on
a position in an image which is designated by a user.

Claim 7 (Canceled).

8. (Currently Amended) An article of manufacture
comprising: a A computer-readable storage medium having
computer-readable program code means stored thereon to assume a
characteristic of a virtual image sensing optical system and
5 apply a blur effect corresponding to a preset in focus state to a
captured image in an image processing apparatus, said
computer-readable program code means comprising:

first computer-readable program means for providing a
computer with a function of capturing image information including
10 distance information to each portion of an object to be
photographed;

second computer-readable program means for providing the
computer with a function of inputting a parameter from which an

Application No. 09/176,910
Response to Office Action

Customer No. 01933

effective aperture and focal length of the an assumed image
15 sensing optical system can be derived;

third computer-readable program means for providing the computer with a function of designating an in-focal pint point position of the assumed image sensing optical system;

fourth computer-readable program means for providing the 20 computer with a function of calculating a blur state from the input distance information, the designated in-focal pint point position, and the input parameter; and

fifth computer-readable program means for providing the computer with a function of applying the a blur effect to the 25 input image in correspondence with the calculated blur state;

wherein the in-focal point position designated by said in-focal point position designation unit is determined using the distance information included in the image information, based on a position which is designated by a user in an image
30 corresponding to the image information.

9. (Currently Amended) An article of manufacture comprising: a A computer-readable storage medium having computer-readable program code means stored thereon to assume a characteristic of a virtual image sensing optical system and apply a blur effect corresponding to an in-focus state to a captured image in an image processing apparatus, said computer-readable program code means comprising:

Application No. 09/476,910
Response to Office Action

Customer No. 01933

first computer-readable program means for providing a computer with a function of capturing image information including
10 distance information to each portion of an object to be photographed;

second computer-readable program means for providing the computer with a function of inputting a parameter from which an effective aperture and focal length of the an assumed image
15 sensing optical system can be derived;

third computer-readable program means for providing the computer with a function of designating an in-focal pint point position of the assumed image sensing optical system;

fourth computer-readable program means for providing the computer with a function of calculating a confusion circle from
20 the input distance information, the designated in-focal pint point position, and the input parameter;

fifth computer-readable program means for providing the computer with a function of calculating a blur state using a
25 point spread function (PSF) within a range corresponding to a size of the calculated confusion circle; and

sixth computer-readable program means for providing the computer with a function of applying the a blur effect to the input image in correspondence with the calculated blur state;

30 wherein the in-focal point position designated by said in-focal point position designation unit is determined using the distance information included in the image information, based on

Application No. 09/476,910
Response to Office Action

Customer No. 01933

a position which is designated by a user in an image
corresponding to the image information.

Claim 10 (Canceled).

11. (Currently Amended) An image processing apparatus comprising:

means for inputting image data including depth information;

means for setting a parameter for expressing a lens
5 characteristic;

means for setting any one of a focal length, F-number, field angle, and effective aperture;

means for setting a distance ~~for adjusting a~~ in focus;

means for calculating expression of an image texture
10 including a blur from the virtual camera setting values and the depth information of the image; and

means for storing a calculation result in a memory

wherein an in-focal point position is determined using the
depth information included in the image data based on a position
15 designated by a user in an image corresponding to the image data.

12. (Original) An apparatus according to claim 11, further comprising means for inputting an image having depth information in units of pixels of a two-dimensional image.

Application No. 09/476,910
Response to Office Action

Customer No. 01933

13. (Currently Amended) An apparatus according to
claim 11, wherein a blur function is a point spread function
(PSF) calculated in units of pixels from the focal length of a
lens, the F-number or aperture, the an object distance, and the
5 depth information of the image data.

14. (Currently Amended) An apparatus according to
claim 11, wherein a blur function has a variable function shape,
and is one of a concave function or and a convex function
determined by a focal pint point position and an object distance
to be calculated.

15. (Currently Amended) An apparatus according to
claim 11, wherein a user can freely change, with a volume, the
F-number and a focal pint point position designated by the user
are adapted to be changeable by the user with a sliding switch,
5 and wherein a calculation result using a thumbnail image obtained
by thinning out an input image is displayed to interactively
obtain a confirmable parameter setting.

Claim 16 (Canceled).

17. (Currently Amended) An apparatus according to
claim 11, wherein a user freely changes the F-number with a
volume is adapted to be changeable by the user with a sliding

Application No. 09/476,910
Response to Office Action

Customer No. 01933

switch while designating the user designates a focal pint point position on a designated window, and wherein a calculation result using a thumbnail image obtained by thinning out an input image is displayed to interactively obtain a parameter setting ~~capable of confirming which is adapted to confirm~~ designation of the focal pint point position and the F-number.

18. (Currently Amended) An apparatus according to claim 11, wherein ~~a user can change a zoom ratio~~ is adapted to be changed by the user by changing an f-number.

19. (Currently Amended) An apparatus according to claim 11, wherein a central point of a zoom and a position to get into focus are set in setting a zoom ratio, and wherein central coordinates of the zoom and depth information of the central point are used to one of calculate a blur state and an enlargement on a window and ~~a blur state or~~ to interactively determine a parameter.

20. (Original) An apparatus according to claim 19, wherein an outer frame in an area to be enlarged and displayed without changing a display ratio is displayed in setting the zoom ratio.

21. (Currently Amended) An apparatus according to claim 11, wherein a window is enlarged based on central

Application No. 09/476,910
Response to Office Action

Customer No. 01933

coordinates of a zoom designated by a user, a focal pint point position on the window is designated to determine the focal pint point position, the F-number is freely changed with a volume sliding switch, and a calculation result using a thumbnail image obtained by thinning out an input image is displayed to interactively obtain a parameter setting ~~capable of confirming which is adapted to confirm~~ designation of a central position of the field angle, a zoom ratio, and the F-number.

22. (Original) An apparatus according to claim 11, wherein a blur state is expressed using influence of coma which changes depending on a distance and azimuth from a center of an image.

23. (Original) An apparatus according to claim 11, wherein an asymmetrical point spread function is calculated for coma using a blur function obtained by shifting a central position of a radius of a confusion circle in accordance with a distance from a central position of an image.

5 Claim 24 (Canceled).

25. (Currently Amended) An apparatus according to claim 11, wherein a range $d-\Delta$ from d on a point spread function for a radius (d) of a symmetrical confusion circle is set as a

Application No. 09/476,910
Response to Office Action

Customer No. 01933

chromatic aberration influence range, and one of red aberration
5 or and blue aberration is applied.

Claim 26 (Canceled).

27. (Currently Amended) An apparatus according to
claim 11, wherein one of a blue range or and a red range of a
color characteristic at not less than a given distance is one of
emphasized or and decreased.

28. (Currently Amended) An apparatus according to
claim 11, further comprising means for inputting, as a set of
units, depth information and image information in units of one of
pixels or and areas for each object.

29. (Currently Amended) An apparatus according to
claim 11, wherein an input image is comprises a set of objects
having a predetermined distance in units of ~~not pixels but sets~~
of objects and not in units of pixels.